

*Idaho National Engineering and Environmental Laboratory*

# ***RELAP5-3D Development & Application Status***

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# Outline

- *Improvements in Version 2.2*
- *Ongoing and future work*
- *Current applications at the INEEL*

# ***RELAP5-3D Version 2.2***

## ***New models and improvements to existing models***

- ***IMPROVED TURBINE MODEL*** – Dissipation term added to energy equation, moisture separator added, new turbine characteristics input.
- ***IMPROVED RADIATION/CONDUCTION ENCLOSURE MODEL*** – Added input check on energy conservation, temperature initialization, removed need to re-input data on restart.
- ***HENRY-FAUSKE CRITICAL FLOW MODEL*** – Made compatible with the nearly-implicit solution scheme

# ***RELAP5-3D Version 2.2***

## ***New models and improvements to existing models (cont'd)***

### ***FLUIDS***

- CO<sub>2</sub> added as a new coolant
- CO<sub>2</sub>, CO, and O<sub>2</sub> added as noncondensables
- Improvements made to supercritical water and helium properties
- ***NEUTRON KINETICS*** - Neutron flux correction was added that corrects either local burnup values or the value of the group 2 fission cross-section that is fed to NESTLE for RBMK reactors.

# ***RELAP5-3D Version 2.2***

## ***New models and improvements to existing models (cont'd)***

- ***GENERATION IV FEATURES ADDED***
  - Westinghouse rod bundle heat transfer correlation for liquid metals
  - Gas diffusion model
- ***COUPLING ENHANCEMENTS***
  - Energy-conserving explicit coupling
  - Allow RELAP5-3D to run in parallel while coupled to another code
  - Allow multiple noncondensable gases in coupled problems.

# ***RELAP5-3D Version 2.2***

## ***New models and improvements to existing models (cont'd)***

- ***PROGRAMMING IMPROVEMENTS***
  - Parallelization completed, except neutron kinetics
  - Bit-packing transformed to FORTRAN 90 protocol
  - Partial backups eliminated for air appearance
- ***USER CONVENIENCES***
  - Allow multiple connections to Time Dependent Volumes.
  - Added inverse kinetics control variable component
  - Added optional noncondensable mass fraction input
  - Allow reflood on left side of heat slab

# ***RGUI Improvements***

- ***Prototype THUMB Deck Builder***
  - Integrated into RGUI
  - Heat slab input added
- ***JAVA Conversion***
- ***Tiff file format***
- ***Movie Capability***

# ***Ongoing and Future Work***

- ***Feedwater Heater Model***
- ***Pressurizer Spray Model***
- ***Compressor Model***
- ***Radiological Transport Model***
- ***Continue FORTRAN 90 conversions***
- ***VHTR Methods Development Plan***
- ***Paper/Pulp Boiler Model***
- ***Continue conversion of RGUI***
- ***Horizontal Stratification Model***

# ***Current Validation/Applications***

- ***International Nuclear Safety Program***
  - Integrated Training and Accident Analysis System station developed for the IAEA
  - Comparative assessment reports for VVER Standard Problems 1, 5 and 7
  - Plant Specific Engineering Handbook
- ***Generation IV reactor studies***
  - NGNP (VHTR)
  - SCWR
  - GCFR
  - LFR